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Data Compilation for AGR-1 Variant 2 Compact Lot LEU01-48T-Z

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This document is a compilation of characterization data for the AGR-1 variant 2 compact lot LEU01-48T-Z. The compacts were produced by ORNL for the Advanced Gas Reactor Fuel Development and Qualification (AGR) program for the first AGR irradiation test train (AGR-1). This compact lot was fabricated using particle composite LEU01-48T, which was a composite of three batches of TRISO-coated 350 μm diameter 19.7% low enrichment uranium oxide/uranium carbide kernels (LEUCO). The AGR-1 TRISO-coated particles consist of a spherical kernel coated with an ~50% dense carbon buffer layer (100 μm nominal thickness), followed by a dense inner pyrocarbon layer (40 μm nominal thickness), followed by a SiC layer (35 μm nominal thickness), followed by another dense outer pyrocarbon layer (40 μm nominal thickness). The kernels were obtained from BWXT and identified as composite G73D-20-69302. The BWXT kernel lot G73D-20-69302 was riffled into sublots for characterization and coating by ORNL and identified as LEU01-## (where ## is a series of integers beginning with 01). A data compilation for the AGR-1 variant 2 coated particle composite LEU01-48T can be found in ORNL/TM-2006/021.

The AGR-1 Fuel Product Specification and Characterization Guidance (INL EDF-4380) provides the requirements necessary for acceptance of the fuel manufactured for the AGR-1 irradiation test. Section 6.2 of EDF-4380 provides the property requirements for the heat treated compacts. The Statistical Sampling Plan for AGR Fuel Materials (INL EDF-4542) provides additional guidance regarding statistical methods for product acceptance and recommended sample sizes. The procedures for characterizing and qualifying the compacts are outlined in ORNL product inspection plan AGR-CHAR-PIP-05. The inspection report forms generated by this product inspection plan document the product acceptance for the property requirements listed in section 6.2 of EDF-4380.

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1 Summary of acceptance test results for LEU01-48T-Z

This section contains inspection report forms (IRFs) associated with the compact lot LEU01-48T-Z. These inspection report forms also appear in a later section of this compilation, accompanied by the associated data report forms (DRFs) showing the results of each individual measurement. These inspection report forms summarize the acceptance testing performed according to the product inspection plan AGR-CHAR-PIP-05. The information in these forms covers all the property specifications listed in section 6.2 of the AGR-1 Fuel Product Specification and Characterization Guidance document INL EDF-4380, Rev. 8. The compact lot, LEU01-48T-Z, was found to meet all the requirements in this section of EDF-4380, Rev. 8 with the exception of 2 compacts which were available for irradiation that did not meet the specified minimum length. These 2 non-conforming compacts have been dispositioned for use as is by NCR-X-AGR-06-04.

Table 1-1 is provided for quick reference. It gives the mean values of key variable properties of the compact lot, LEU01-48T-Z. For standard deviations of the distribution of the measured values see the appropriate IRF or DRF. For discussions on the uncertainty in these values, see the associated data acquisition methods and data report forms.

Table 1-1: Quick reference table for key variable properties of LEU01-48T-Z.

Property	Mean
Mean uranium loading (g U/compact)	0.904
Compact diameter (mm)	12.36
Compact length (mm)	25.07
Compact mass (g)	5.37
Impurity content	Table 1-2

The mean impurity levels for the fuel compacts reported on IRF-05A and IRF-05B are probably higher than the actual values for two reasons. First, the as-reported mean impurity levels do not reflect the fact that some of the measurements were at or below the measurement threshold and could not be differentiated from zero. Second, the as-reported mean impurity levels do not account for impurities introduced during the analysis.

Each time a leach was performed, a blank run was also performed where all the relevant wet chemistry steps in the leach-burn-leach procedure in AGR-CHAR-DAM-26R0 were performed without a compact present in order to obtain background values for the analyzed impurities. Table 1-2 shows the total as-reported mean and standard deviation for each measured impurity as well as the total mean values adjusted by subtracting the background values obtained from the associated blank runs. In cases where the value for the blank run was reported as being below a certain measurement threshold value, a minimum value for that leach was calculated by subtracting the threshold value and a maximum value was calculated by subtracting zero. The adjusted mean therefore accounts for all the measurable impurities in the blanks and spans a range that reflects the uncertainty due to the measurement thresholds.

Table 1-2: Mean impurity levels for fuel compacts from LEU-48T-Z compact lot measured by deconsolidation leach-burn-leach technique.

Measured Impurity	As-reported Mean	Adjusted Mean	
		Minimum	Maximum
Fe outside SiC ($\mu\text{g}/\text{compact}$):	4.83 ± 1.78	1.88 ± 1.33	1.88 ± 1.33
Cr outside SiC ($\mu\text{g}/\text{compact}$):	0.68 ± 0.08	0.02 ± 0.02	0.50 ± 0.02
Mn outside SiC ($\mu\text{g}/\text{compact}$):	0.11 ± 0.01	0.02 ± 0.01	0.08 ± 0.01
Co outside SiC ($\mu\text{g}/\text{compact}$):	0.198 ± 0.003	0.001 ± 0.002	0.193 ± 0.002
Ni outside SiC ($\mu\text{g}/\text{compact}$):	2.04 ± 1.35	1.39 ± 1.31	1.64 ± 1.35
Cr+Mn+Co+Ni outside SiC ($\mu\text{g}/\text{compact}$):	3.03 ± 1.33	1.43 ± 1.32	2.41 ± 1.35
Ca outside SiC ($\mu\text{g}/\text{compact}$):	29.00 ± 5.88	11.79 ± 2.68	15.13 ± 2.68
Al outside SiC ($\mu\text{g}/\text{compact}$):	13.69 ± 2.41	7.88 ± 2.40	11.21 ± 2.40
Ti outside SiC ($\mu\text{g}/\text{compact}$):	11.64 ± 0.81	10.99 ± 0.80	11.57 ± 0.80
V outside SiC ($\mu\text{g}/\text{compact}$):	20.92 ± 0.73	20.64 ± 0.73	20.90 ± 0.73
Ti + V outside SiC ($\mu\text{g}/\text{compact}$):	32.56 ± 0.87	31.63 ± 0.86	32.46 ± 0.86

Table 1-3 is also provided for quick reference. It gives the upper limit of the 95% confidence interval of the defect fraction for key attribute properties of the compact lot LEU01-48T-Z. In other words, these values are the lowest tolerance limits for which the compact lot would be deemed acceptable at 95% confidence based on the particular sample that was measured. For the actual number of trials and number of failures observed, see the inspection report form for the compact lot.

Table 1-3: Quick reference table for key attribute properties of LEU01-48T-Z.

Property	Defect Fraction
Uranium contamination fraction	$\leq 3.1 \cdot 10^{-5}$
Defective SiC coating fraction	$\leq 9.6 \cdot 10^{-5}$
Defective IPyC coating fraction	$\leq 6.1 \cdot 10^{-5}$
Defective OPyC coating fraction	$\leq 7.3 \cdot 10^{-4}$

Also worthy of note is the observation of particles with SiC layers less than $20 \mu\text{m}$ thick. These were observed and noted for information only during x-ray analysis for uranium dispersion after compacting due to defective IPyC. In terms of the upper limit of the 95% confidence interval of the anomaly fraction, as reported in Table 1-3, the fraction of particles in the compact lot with SiC $< 20 \mu\text{m}$ thick is $\leq 9.0 \cdot 10^{-4}$. This anomaly is probably caused by particles being temporarily trapped in carbon soot that has built up on the walls of the coating chamber above the fluidized particle bed. This is the same mechanism thought to cause soot inclusions (goldspots) within the SiC layer.

DRF-24 indicates that 5 compacts failed to meet the length specification, being shorter than the lower acceptance limit of 25.02 mm. Of the 5 compacts that were shorter than 25.02 mm, 3 were selected for destructive characterization according to AGR-CHAR-PIP-05R0. The remaining 2 compacts that were shorter than 25.02 mm were available for irradiation and dispositioned for use as is by NCR-X-AGR-06-04. Table 1-4 lists the compacts that are available for irradiation sorted in order of increasing length.

Table 1-4: Compacts from LEU-48T-Z compact lot available for irradiation sorted by length

Compact ID Number	Length (mm)	Diameter (mm)						Pass Thru? (Y or N)	Mass (g)	Accept? (pass or fail)
		Top 1	Top 2	Middle 1	Middle 2	Bottom 1	Bottom 2			
02	25.011	12.36	12.36	12.36	12.36	12.34	12.35	Y	5.3620	fail
66	25.012	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3613	fail
45	25.022	12.36	12.36	12.36	12.37	12.35	12.35	Y	5.3710	pass
09	25.025	12.36	12.36	12.36	12.36	12.35	12.34	Y	5.3665	pass
36	25.025	12.38	12.37	12.38	12.36	12.35	12.35	Y	5.3503	pass
53	25.040	12.37	12.36	12.37	12.37	12.35	12.35	Y	5.3545	pass
24	25.043	12.36	12.36	12.37	12.37	12.35	12.36	Y	5.3445	pass
07	25.046	12.35	12.36	12.36	12.36	12.35	12.35	Y	5.3579	pass
19	25.048	12.36	12.36	12.36	12.37	12.35	12.35	Y	5.3613	pass
37	25.050	12.36	12.37	12.36	12.37	12.35	12.36	Y	5.3570	pass
29	25.052	12.36	12.36	12.37	12.37	12.35	12.35	Y	5.3605	pass
44	25.053	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3776	pass
13	25.057	12.36	12.36	12.37	12.36	12.36	12.36	Y	5.3589	pass
67	25.057	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3686	pass
04	25.058	12.36	12.37	12.36	12.37	12.35	12.36	Y	5.3693	pass
58	25.064	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3738	pass
63	25.064	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3620	pass
46	25.068	12.36	12.35	12.36	12.36	12.35	12.35	Y	5.3644	pass
06	25.072	12.36	12.37	12.36	12.37	12.35	12.35	Y	5.3815	pass
03	25.074	12.36	12.36	12.36	12.36	12.36	12.35	Y	5.3766	pass
41	25.074	12.36	12.36	12.36	12.37	12.37	12.35	Y	5.3606	pass
14	25.076	12.36	12.36	12.37	12.36	12.35	12.35	Y	5.3290	pass
27	25.076	12.36	12.36	12.36	12.36	12.35	12.36	Y	5.3717	pass
60	25.078	12.37	12.36	12.36	12.36	12.35	12.35	Y	5.3766	pass
43	25.079	12.36	12.36	12.36	12.36	12.35	12.36	Y	5.3585	pass
34	25.083	12.36	12.36	12.36	12.36	12.37	12.37	Y	5.3589	pass
38	25.087	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3541	pass
55	25.087	12.35	12.35	12.36	12.35	12.35	12.35	Y	5.3612	pass
65	25.087	12.36	12.36	12.36	12.37	12.35	12.35	Y	5.3678	pass
20	25.096	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3572	pass
23	25.097	12.36	12.36	12.37	12.37	12.35	12.36	Y	5.3736	pass
56	25.106	12.36	12.36	12.36	12.36	12.36	12.35	Y	5.3620	pass
16	25.107	12.36	12.37	12.37	12.37	12.35	12.36	Y	5.3746	pass
15	25.129	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3680	pass
12	25.163	12.37	12.36	12.37	12.37	12.35	12.36	Y	5.3715	pass
61	25.349	12.37	12.37	12.37	12.37	12.36	12.36	Y	5.5696	pass

Inspection Report Form IRF-05A: Fuel Compact Lots

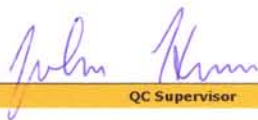
Procedure:	AGR-CHAR-PIP-05 Rev. 0
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T-Z
Compact ID numbers of compacts available for irradiation test (pending acceptance):	02,03,04,06,07,09,12,13,14,15,16,19,20,23,24,27,29,34 36,37,38,41,43,44,45,46,53,55,56,58,60,61,63,65,66,67

Property	Measured Data				Specification	Acceptance Criteria	Acceptance Test Value	Pass or fail	Data Records
	Mean (x)	Std. Dev. (s)	Measurements (n)	k or t value	INL EDF-4380 Rev. 8				
Compact diameter (mm)	See DRF-24				12.22 - 12.46	all available for irradiation test meet specification		Note 1	DRF-24
Compact length (mm)					25.02 - 25.40				
Uranium loading (gU/compact)	0.904	0.003	6	2.015	0.905 ± 0.04	A = $x - ts/\sqrt{n} \geq 0.865$ B = $x + ts/\sqrt{n} \leq 0.945$	0.902 0.906	pass pass	DRF-25
Iron content outside SiC (µg/compact)	4.83	1.78	4	2.353	mean ≤ 25	B = $x + ts/\sqrt{n} \leq 25$	6.9	pass	IRF-05B
				7.042	dispersion ≤ 0.01 ≥ 100	D = $x + \sqrt{3}ks < 100$	26.5	pass	DRF-26
Chromium content outside SiC (µg/compact)	0.68	0.08	4	2.353	mean ≤ 75	B = $x + ts/\sqrt{n} \leq 75$	0.8	pass	IRF-05B DRF-26
Manganese content outside SiC (µg/compact)	0.11	0.01	4	2.353	mean ≤ 75	B = $x + ts/\sqrt{n} \leq 75$	0.1	pass	IRF-05B DRF-26
Cobalt content outside SiC (µg/compact)	0.198	0.003	4	2.353	mean ≤ 75	B = $x + ts/\sqrt{n} \leq 75$	0.2	pass	IRF-05B DRF-26
Nickel content outside SiC (µg/compact)	2.04	1.35	4	2.353	mean ≤ 75	B = $x + ts/\sqrt{n} \leq 75$	3.6	pass	IRF-05B DRF-26
Cr + Mn + Co + Ni content outside SiC (µg/compact)	3.03	1.33	4	7.042	dispersion ≤ 0.01 ≥ 300	D = $x + \sqrt{3}ks < 300$	19.3	pass	IRF-05B DRF-26
Calcium content outside SiC (µg/compact)	29.00	5.88	4	2.353	mean ≤ 90	B = $x + ts/\sqrt{n} \leq 90$	35.9	pass	IRF-05B DRF-26
Aluminum content outside SiC (µg/compact)	13.69	2.41	4	2.353	mean ≤ 45	B = $x + ts/\sqrt{n} \leq 45$	16.5	pass	IRF-05B DRF-26
Ti + V content outside SiC (µg/compact)	32.56	0.87	4	2.353	mean ≤ 400	B = $x + ts/\sqrt{n} \leq 400$	33.6	pass	IRF-05B DRF-26

Property	Measured Data		Specification	Acceptance Criteria	Acceptance Test Value	Pass or fail	Data Records
	# of compacts	# of particles	INL EDF-4380				
Uranium contamination fraction (g exposed U/gram U in compact)	24	99110	≤ 1.0 × 10 ⁻⁴	≤ 4 effectively exposed kernels in ≥ 91533 particles	0	pass	IRF-05C DRF-26
Defective SiC coating fraction (fraction of total particles)	12	49555	≤ 2.0 × 10 ⁻⁴	≤ 4 leached kernels in ≥ 45766 particles or ≤ 12 leached kernels in ≥ 97210 particles	1	pass	IRF-05D DRF-26
Defective IPyC coating fraction (fraction of total particles)	12	49555	≤ 2.0 × 10 ⁻⁴	≤ 4 with excessive U dispersion in ≥ 45766 particles or ≤ 12 with excessive U dispersion in ≥ 97210 particles	0	pass	DRF-28
Defective OPyC coating fraction (fraction of total particles)	1	4130	≤ 0.01	≤ 6 cracked or missing OPyC in ≥ 1182 particles or ≤ 30 cracked or missing OPyC in ≥ 4064 particles	0	pass	DRF-27

Comments

Note 1: 2 compacts in lot LEU01-48T-Z listed above as available for irradiation were below 25.02 mm in length, these were accepted for use as is per NCR-X-AGR-06-04.
 Note 2: Per EDF-4380, a specification on Cl content outside SiC is not applicable because HCl cleaning of compacts was not performed.



QC Supervisor

7-19-06

Date

Accept compact lot (Yes or No):

Yes



QA Reviewer

7/20/06

Date

Inspection Report Form IRF-05B: Summary of Impurities Outside SiC

Procedure:	AGR-CHAR-PIP-05 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact Lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T

Compact ID numbers:	40, 54, 62	18, 25, 52	10, 35, 42	17, 26, 30	Mean	Standard Deviation
Number of compacts:	3	3	3	3		
Iron						
Deconsolidation-leach (DRF-26A) (µg):	8.60	6.69	10.07	18.40		
Burn-leach (DRF-26B) (µg):	4.36	2.73	3.48	3.64		
Total leached (µg):	12.96	9.42	13.55	22.04		
Fe outside SiC (µg/compact):	4.32	3.14	4.52	7.35	4.83	1.78
Chromium						
Deconsolidation-leach (DRF-26A) (µg):	0.42	0.42	0.78	0.87		
Burn-leach (DRF-26B) (µg):	1.41	1.41	1.41	1.41		
Total leached (µg):	1.84	1.83	2.19	2.28		
Cr outside SiC (µg/compact):	0.61	0.61	0.73	0.76	0.68	0.08
Manganese						
Deconsolidation-leach (DRF-26A) (µg):	0.10	0.10	0.12	0.16		
Burn-leach (DRF-26B) (µg):	0.20	0.20	0.20	0.20		
Total leached (µg):	0.30	0.30	0.33	0.37		
Mn outside SiC (µg/compact):	0.10	0.10	0.11	0.12	0.11	0.01
Cobalt						
Deconsolidation-leach (DRF-26A) (µg):	0.025	0.024	0.036	0.039		
Burn-leach (DRF-26B) (µg):	0.564	0.564	0.564	0.564		
Total leached (µg):	0.589	0.588	0.600	0.603		
Co outside SiC (µg/compact):	0.196	0.196	0.200	0.201	0.198	0.003
Nickel						
Deconsolidation-leach (DRF-26A) (µg):	0.83	2.49	0.83	1.00		
Burn-leach (DRF-26B) (µg):	2.25	8.73	1.87	6.51		
Total leached (µg):	3.08	11.22	2.70	7.51		
Ni outside SiC (µg/compact):	1.03	3.74	0.90	2.50	2.04	1.35
Transition Metals						
Cr+Mn+Co+Ni outside SiC (µg/compact):	1.93	4.65	1.94	3.59	3.03	1.33
Calcium						
Deconsolidation-leach (DRF-26A) (µg):	47.10	52.30	76.00	90.40		
Burn-leach (DRF-26B) (µg):	20.20	26.84	17.50	17.60		
Total leached (µg):	67.30	79.14	93.50	108.00		
Ca outside SiC (µg/compact):	22.43	26.38	31.17	36.00	29.00	5.88
Aluminum						
Deconsolidation-leach (DRF-26A) (µg):	21.19	34.80	32.79	20.90		
Burn-leach (DRF-26B) (µg):	13.63	13.65	13.29	14.01		
Total leached (µg):	34.82	48.45	46.08	34.91		
Al outside SiC (µg/compact):	11.61	16.15	15.36	11.64	13.69	2.41
Titanium						
Deconsolidation-leach (DRF-26A) (µg):	14.01	18.45	16.58	15.81		
Burn-leach (DRF-26B) (µg):	22.16	16.06	15.14	21.49		
Total leached (µg):	36.17	34.51	31.72	37.30		
Ti outside SiC (µg/compact):	12.06	11.50	10.57	12.43	11.64	0.81
Vanadium						
Deconsolidation-leach (DRF-26A) (µg):	27.82	29.24	29.03	28.91		
Burn-leach (DRF-26B) (µg):	32.34	36.25	33.93	33.49		
Total leached (µg):	60.16	65.49	62.96	62.40		
V outside SiC (µg/compact):	20.05	21.83	20.99	20.80	20.92	0.73
Titanium and Vanadium						
Ti + V outside SiC (µg/compact):	32.11	33.33	31.56	33.23	32.56	0.87


 QC Supervisor

 7-18-06
 Date

Inspection Report Form IRF-05C: Summary of Uranium Contamination

Procedure:	AGR-CHAR-PIP-05 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact Lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T

Compact ID numbers:	40, 54, 62	18, 25, 52	10, 35, 42	17, 26, 30	11, 22, 32, 33, 51, 64	01, 28, 47, 48, 49, 59	Total
Number of compacts:	3	3	3	3	6	6	24
Effective number of exposed kernels:	0.0	0.0	0.0	0.0	0.0	0.0	0.0


QC Supervisor

7-18-06
Date

Inspection Report Form IRF-05D: Summary of SiC Burn-Leach Defects

Procedure:	AGR-CHAR-PIP-05 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact Lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T

Compact ID numbers:	40, 54, 62	18, 25, 52	10, 35, 42	17, 26, 30			Total
Number of compacts:	3	3	3	3			12
Number of leached kernels:	0	0	0	1			1

John *Almon*

QC Supervisor

7-18-06

Date

2 Compacting process conditions

LEU01-48T TRISO (variant 2) particles were received from the characterization group after removing particles for characterization according to AGR-CHAR-PIP-04R2, “Product Inspection Plan for Coated Particle Composites.” Fifteen ~20 g aliquots were prepared via riffing, and one aliquot was used per overcoating run. Prior to overcoating, the particles were washed in methanol per procedure AGR-TRISOWASH-SOP-1, “Standard Operating Procedure for TRISO Particle Washing.” Washing of particles prior to overcoating was adapted in order to help reduce the amount of contamination on the particles that may have been acquired during processing or general handling. The washing procedure was adopted from General Atomics’ particle washing procedures.

After washing, the LEU01-48T particles were overcoated using matrix batch GKRS 030906. All of the aliquots were overcoated producing 371 g of +18 particles. “+18” particles are those that pass through an ASTM E11 No. 16 sieve (1.18 mm) but do not pass through and ASTM E11 No. 18 sieve (1.00 mm).

The 371 g of +18 particles was then tabled and 358 g of +18 Bin 3 particles were recovered. “Bin 3” particles are those particles that end up in the third bin of the tabler; these are the most spherical of the +18 particles. The yield of +18 Bin 3 variant 2 particles was 96%, which was also the yield of Bin 3 particles for variant 1 +18 particles. 358 g of +18 Bin 3 overcoated particles was determined to be a sufficient quantity to produce at least 67 compacts, based on preliminary calculations.

Based on an average kernel weight of $2.42 \cdot 10^{-4}$ g and a wt% uranium of 0.9006 for the AGR-1 kernels, 4151 particles are needed in each compact to obtain a uranium loading of 0.905 g. The average +18 Bin 3 overcoated particle weight was measured (according to AGR-CHAR-DAM-22, “Data Acquisition Method for Estimation of Average Particle Weight”) to be $1.19 \cdot 10^{-3}$ g. Using this value, a compact charge of 4.94 g of +18 Bin 3 overcoated particles would be required for a compact uranium loading of 0.905 g. As an alternate approach for calculating the compact charge, a quantity of +18 Bin 3 overcoated particles was rinsed and the ratio of overcoated particle weight to TRISO particle weight was determined to be 1.656. 4151 particles corresponds to 3.005 g TRISO particles (given an average weight of AGR-1 variant 2 TRISO particle of $7.24 \cdot 10^{-4}$ g). Using this second approach, a compact charge of 4.98 g of +18 Bin 3 overcoated particles would be required for a compact uranium loading of 0.905 g. Given that the uranium loading measurements from baseline and variant 1 indicated that the compact charge calculated from the measured average overcoated particle weight (the first approach) was the more accurate method for determining uranium loading, a compact charge of 4.94 g was used to obtain a uranium loading close to 0.905 g.

The 358 g quantity of +18 Bin 3 overcoated particles was rotary riffled into aliquots of approximately 4.10 g. Additional +18 Bin 3 overcoated particles were added to each aliquot by scoop sampling until the desired 4.94 g compact charge was reached. Compacts were then made from the 4.94 g aliquots. Steps were taken in the process to increase the malleability of the

overcoat, which helped aid the compaction process, densify the compact, and create a smoother, less porous outer surface. A 0.30 g quantity of matrix powder was added to the compacting mold prior to the addition of overcoated particles. Another 0.30g quantity of matrix was added to the mold after addition of the overcoated particles, such that the overcoated particles were compressed between two matrix “end caps” during fabrication. The compact is pressed by applying force to a top ram. The presence of the end caps helps to buffer the particles during compacting, and also provides a smooth, sharp end in the green compact.

71 AGR-1 variant 2 compacts were fabricated. All of the 71 green compacts were subsequently carbonized and heat treated. 67 compacts were selected from this batch of 71 and delivered to the characterization group. The selection of the 67 compacts for the characterization group was based on length measurements at each stage of compacting (green, carbonization, and heat-treatment), and visual inspection for surface irregularities.

AGR-1 Process Conditions

The AGR-1 process limits from EDF-4380, Rev. 8 are listed below.

AGR-1 Process Limits: Molding Pressure <60 MPa

Carbonization parameters: <350°C/hr in He
Hold at 950 ± 50°C for 1.0 ± 0.4 hr
Furnace cool

Heat treatment parameters: ~20°C/min in vacuum
Hold at 1650-1850°C for 60 ± 10 min
Furnace cool at ~20°C/min to below 700°C

Table 2-1 shows the process conditions used in molding the compacts, carbonizing the compacts, and heat treating the compacts. In the carbonization regime, the furnace was allowed to cool under no power (i.e., after holding at 950°C for 1 hour, power was turned off). In the heat treatment run, the furnace was cooled under power until the furnace temperature reached 700°C. The rate of cooling was 20°C/min.

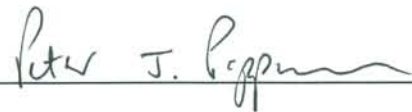
Conclusion

The LEU01-48T-Z (AGR-1 variant 2) compact lot was made in accordance with the AGR-1 process limits listed in EDF-4380, Rev. 8.

Table 2-1: Summary of process conditions used in making LEU01-48T-Z (AGR-1 variant 2) compacts

Compact ID	Carbonization Parameter					Heat-treatment Parameters			
	Molding Pressure (MPa)	Heating Rate (°C/min.)	Max. Temp. (°C)	Hold Time (hrs.)	Atmosphere	Heating Rate (°C/min.)	Max. Temp. (°C)	Hold Time (hrs.)	Atmosphere
LEU01-48T-Z01	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z02	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z03	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z04	10.21	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z05	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z06	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z07	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z08	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z09	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z10	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z11	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z12	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z13	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z14	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z15	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z16	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z17	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z18	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z19	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z20	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z21	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z22	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z23	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z24	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z25	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z26	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z27	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z28	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z29	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z30	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z31	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z32	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z33	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z34	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z35	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z36	9.28	4.7	950	1	flowing He	20	1800	1	vacuum

Task Manager Review



Date

8-1-06

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Date

8/1/06

Table 2-1 (cont.). Summary of process conditions used in making LEU01-48T-Z (AGR-1 variant 2) compacts

Compact ID	Carbonization Parameter					Heat-treatment Parameters			
	Molding Pressure (MPa)	Heating Rate (°C/min.)	Max. Temp. (°C)	Hold Time (hrs.)	Atmosphere	Heating Rate (°C/min.)	Max. Temp. (°C)	Hold Time (hrs.)	Atmosphere
LEU01-48T-Z37	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z38	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z39	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z40	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z41	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z42	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z43	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z44	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z45	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z46	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z47	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z48	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z49	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z50	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z51	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z52	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z53	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z54	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z55	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z56	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z57	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z58	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z59	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z60	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z61	13.92	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z62	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z63	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z64	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z65	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z66	9.28	4.7	950	1	flowing He	20	1800	1	vacuum
LEU01-48T-Z67	9.28	4.7	950	1	flowing He	20	1800	1	vacuum

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8-1-06

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8/1/06

3 Characterization of compacts

This section contains acceptance testing data on the compact lot LEU01-48T-Z. The data was obtained according to product inspection plan AGR-CHAR-PIP-05R0.

The following pages show the inspection report forms (IRF-05A, IRF-05B, IRF-05C, IRF-05D) for the LEU01-48T-Z compacts. Following the IRF-05 inspection report forms are the individual data report forms for the measurements that were performed. This compact lot was determined to satisfy the specifications in section 6.2 of the AGR-1 Fuel Product Specification and Characterization Guidance document INL EDF-4380, Rev. 8, with the exception of 2 compacts which were available for irradiation that did not meet the specified minimum length. These 2 non-conforming compacts have been dispositioned for use as is by NCR-X-AGR-06-04.

Inspection Report Form IRF-05A: Fuel Compact Lots

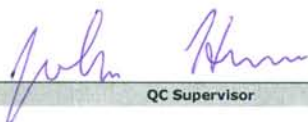
Procedure:	AGR-CHAR-PIP-05 Rev. 0
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T-Z
Compact ID numbers of compacts available for irradiation test (pending acceptance):	02,03,04,06,07,09,12,13,14,15,16,19,20,23,24,27,29,34 36,37,38,41,43,44,45,46,53,55,56,58,60,61,63,65,66,67

Property	Measured Data				Specification	Acceptance Criteria	Acceptance Test Value	Pass or fail	Data Records
	Mean (x)	Std. Dev. (s)	Measurements (n)	k or t value	INL EDF-4380 Rev. 8				
Compact diameter (mm)	See DRF-24				12.22 - 12.46	all available for irradiation test meet specification		Note 1	DRF-24
Compact length (mm)					25.02 - 25.40				
Uranium loading (gU/compact)	0.904	0.003	6	2.015	0.905 ± 0.04	A = $x - ts/\sqrt{n} \geq 0.865$ B = $x + ts/\sqrt{n} \leq 0.945$	0.902 0.906	pass pass	DRF-25
Iron content outside SIC (µg/compact)	4.83	1.78	4	2.353	mean ≤ 25	B = $x + ts/\sqrt{n} \leq 25$	6.9	pass	IRF-05B DRF-26
				7.042	dispersion ≤ 0.01 ≥ 100	D = $x + \sqrt{3ks} < 100$	26.5	pass	
Chromium content outside SIC (µg/compact)	0.68	0.08	4	2.353	mean ≤ 75	B = $x + ts/\sqrt{n} \leq 75$	0.8	pass	IRF-05B DRF-26
Manganese content outside SIC (µg/compact)	0.11	0.01	4	2.353	mean ≤ 75	B = $x + ts/\sqrt{n} \leq 75$	0.1	pass	IRF-05B DRF-26
Cobalt content outside SIC (µg/compact)	0.198	0.003	4	2.353	mean ≤ 75	B = $x + ts/\sqrt{n} \leq 75$	0.2	pass	IRF-05B DRF-26
Nickel content outside SIC (µg/compact)	2.04	1.35	4	2.353	mean ≤ 75	B = $x + ts/\sqrt{n} \leq 75$	3.6	pass	IRF-05B DRF-26
Cr + Mn + Co + Ni content outside SIC (µg/compact)	3.03	1.33	4	7.042	dispersion ≤ 0.01 ≥ 300	D = $x + \sqrt{3ks} < 300$	19.3	pass	IRF-05B DRF-26
Calcium content outside SIC (µg/compact)	29.00	5.88	4	2.353	mean ≤ 90	B = $x + ts/\sqrt{n} \leq 90$	35.9	pass	IRF-05B DRF-26
Aluminum content outside SIC (µg/compact)	13.69	2.41	4	2.353	mean ≤ 45	B = $x + ts/\sqrt{n} \leq 45$	16.5	pass	IRF-05B DRF-26
Ti + V content outside SIC (µg/compact)	32.56	0.87	4	2.353	mean ≤ 400	B = $x + ts/\sqrt{n} \leq 400$	33.6	pass	IRF-05B DRF-26

Property	Measured Data		Specification	Acceptance Criteria	Acceptance Test Value	Pass or fail	Data Records
	# of compacts	# of particles	INL EDF-4380				
Uranium contamination fraction (g exposed U/gram U in compact)	24	99110	≤ 1.0 × 10 ⁻⁴	≤ 4 effectively exposed kernels in ≥ 91533 particles	0	pass	IRF-05C DRF-26
Defective SiC coating fraction (fraction of total particles)	12	49555	≤ 2.0 × 10 ⁻⁴	≤ 4 leached kernels in ≥ 45766 particles or ≤ 12 leached kernels in ≥ 97210 particles	1	pass	IRF-05D DRF-26
Defective IPyC coating fraction (fraction of total particles)	12	49555	≤ 2.0 × 10 ⁻⁴	≤ 4 with excessive U dispersion in ≥ 45766 particles or ≤ 12 with excessive U dispersion in ≥ 97210 particles	0	pass	DRF-28
Defective OPyC coating fraction (fraction of total particles)	1	4130	≤ 0.01	≤ 6 cracked or missing OPyC in ≥ 1182 particles or ≤ 30 cracked or missing OPyC in ≥ 4064 particles	0	pass	DRF-27

Comments

Note 1: 2 compacts in lot LEU01-48T-Z listed above as available for irradiation were below 25.02 mm in length, these were accepted for use as is per NCR-X-AGR-06-04.
Note 2: Per EDF-4380, a specification on CI content outside SIC is not applicable because HCl cleaning of compacts was not performed.


QC Supervisor

7-19-06

Date

Accept compact lot (Yes or No): Yes


QA Reviewer

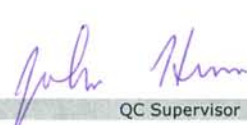
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Date

Inspection Report Form IRF-05B: Summary of Impurities Outside SiC

Procedure:	AGR-CHAR-PIP-05 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact Lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T

Compact ID numbers:	40, 54, 62	18, 25, 52	10, 35, 42	17, 26, 30	Mean	Standard Deviation
Number of compacts:	3	3	3	3		
Iron						
Deconsolidation-leach (DRF-26A) (µg):	8.60	6.69	10.07	18.40		
Burn-leach (DRF-26B) (µg):	4.36	2.73	3.48	3.64		
Total leached (µg):	12.96	9.42	13.55	22.04		
Fe outside SiC (µg/compact):	4.32	3.14	4.52	7.35	4.83	1.78
Chromium						
Deconsolidation-leach (DRF-26A) (µg):	0.42	0.42	0.78	0.87		
Burn-leach (DRF-26B) (µg):	1.41	1.41	1.41	1.41		
Total leached (µg):	1.84	1.83	2.19	2.28		
Cr outside SiC (µg/compact):	0.61	0.61	0.73	0.76	0.68	0.08
Manganese						
Deconsolidation-leach (DRF-26A) (µg):	0.10	0.10	0.12	0.16		
Burn-leach (DRF-26B) (µg):	0.20	0.20	0.20	0.20		
Total leached (µg):	0.30	0.30	0.33	0.37		
Mn outside SiC (µg/compact):	0.10	0.10	0.11	0.12	0.11	0.01
Cobalt						
Deconsolidation-leach (DRF-26A) (µg):	0.025	0.024	0.036	0.039		
Burn-leach (DRF-26B) (µg):	0.564	0.564	0.564	0.564		
Total leached (µg):	0.589	0.588	0.600	0.603		
Co outside SiC (µg/compact):	0.196	0.196	0.200	0.201	0.198	0.003
Nickel						
Deconsolidation-leach (DRF-26A) (µg):	0.83	2.49	0.83	1.00		
Burn-leach (DRF-26B) (µg):	2.25	8.73	1.87	6.51		
Total leached (µg):	3.08	11.22	2.70	7.51		
Ni outside SiC (µg/compact):	1.03	3.74	0.90	2.50	2.04	1.35
Transition Metals						
Cr+Mn+Co+Ni outside SiC (µg/compact):	1.93	4.65	1.94	3.59	3.03	1.33
Calcium						
Deconsolidation-leach (DRF-26A) (µg):	47.10	52.30	76.00	90.40		
Burn-leach (DRF-26B) (µg):	20.20	26.84	17.50	17.60		
Total leached (µg):	67.30	79.14	93.50	108.00		
Ca outside SiC (µg/compact):	22.43	26.38	31.17	36.00	29.00	5.88
Aluminum						
Deconsolidation-leach (DRF-26A) (µg):	21.19	34.80	32.79	20.90		
Burn-leach (DRF-26B) (µg):	13.63	13.65	13.29	14.01		
Total leached (µg):	34.82	48.45	46.08	34.91		
Al outside SiC (µg/compact):	11.61	16.15	15.36	11.64	13.69	2.41
Titanium						
Deconsolidation-leach (DRF-26A) (µg):	14.01	18.45	16.58	15.81		
Burn-leach (DRF-26B) (µg):	22.16	16.06	15.14	21.49		
Total leached (µg):	36.17	34.51	31.72	37.30		
Ti outside SiC (µg/compact):	12.06	11.50	10.57	12.43	11.64	0.81
Vanadium						
Deconsolidation-leach (DRF-26A) (µg):	27.82	29.24	29.03	28.91		
Burn-leach (DRF-26B) (µg):	32.34	36.25	33.93	33.49		
Total leached (µg):	60.16	65.49	62.96	62.40		
V outside SiC (µg/compact):	20.05	21.83	20.99	20.80	20.92	0.73
Titanium and Vanadium						
Ti + V outside SiC (µg/compact):	32.11	33.33	31.56	33.23	32.56	0.87

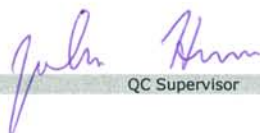

 QC Supervisor

 7-18-06
 Date

Inspection Report Form IRF-05C: Summary of Uranium Contamination

Procedure:	AGR-CHAR-PIP-05 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact Lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T

Compact ID numbers:	40, 54, 62	18, 25, 52	10, 35, 42	17, 26, 30	11, 22, 32, 33, 51, 64	01, 28, 47, 48, 49, 59	Total
Number of compacts:	3	3	3	3	6	6	24
Effective number of exposed kernels:	0.0	0.0	0.0	0.0	0.0	0.0	0.0



QC Supervisor

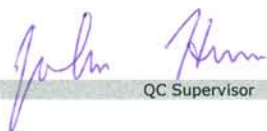
7-18-06

Date

Inspection Report Form IRF-05D: Summary of SiC Burn-Leach Defects

Procedure:	AGR-CHAR-PIP-05 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact Lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T

Compact ID numbers:	40, 54, 62	18, 25, 52	10, 35, 42	17, 26, 30			Total
Number of compacts:	3	3	3	3			12
Number of leached kernels:	0	0	0	1			1


QC Supervisor

7-18-06

Date

Data Report Form DRF-24: Compact Diameter and Length

Procedure:	AGR-CHAR-DAM-24 Rev. 3
Operator:	Ivan Dunbar
Compact lot ID:	LEU01-48T-Z
Compact Lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T-Z
Filename:	\\mc-agr\AGR\CompactDimensions\LEU01-48T-Z_DRF24R3.xls

Vertical height gauge calibration due date:	9/8/06
Pass-thru block calibration due date:	1/17/09
Digital caliper calibration due date:	9/8/06
Gauge blocks calibration due date:	9/8/06

Acceptance criteria for compact length:	≥ 25.02 and ≤ 25.40 mm
Acceptance criteria for compact diameter:	≥ 12.22 and ≤ 12.46 mm (and pass through 12.46 mm ring gauge)
Acceptance criteria for compact mass:	For information only

Compact ID Number	Length (mm)	Diameter (mm)						Pass Thru? (Y or N)	Mass (g)	Accept? (pass or fail)
		Top 1	Top 2	Middle 1	Middle 2	Bottom 1	Bottom 2			
01	25.022	12.36	12.36	12.36	12.36	12.35	12.34	Y	5.3507	pass
02	25.011	12.36	12.36	12.36	12.36	12.34	12.35	Y	5.3620	fail
03	25.074	12.36	12.36	12.36	12.36	12.36	12.35	Y	5.3766	pass
04	25.058	12.36	12.37	12.36	12.37	12.35	12.36	Y	5.3693	pass
05	25.049	12.37	12.38	12.38	12.35	12.35	12.36	Y	5.3579	pass
06	25.072	12.36	12.37	12.36	12.37	12.35	12.35	Y	5.3815	pass
07	25.046	12.35	12.36	12.36	12.36	12.35	12.35	Y	5.3579	pass
08	25.076	12.37	12.37	12.36	12.37	12.36	12.35	Y	5.3611	pass
09	25.025	12.36	12.36	12.36	12.36	12.35	12.34	Y	5.3665	pass
10	25.073	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3558	pass
11	25.079	12.36	12.36	12.36	12.37	12.35	12.35	Y	5.3654	pass
12	25.163	12.37	12.36	12.37	12.37	12.35	12.36	Y	5.3715	pass
13	25.057	12.36	12.36	12.37	12.36	12.36	12.36	Y	5.3589	pass
14	25.076	12.36	12.36	12.37	12.36	12.35	12.35	Y	5.3290	pass
15	25.129	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3680	pass
16	25.107	12.36	12.37	12.37	12.37	12.35	12.36	Y	5.3746	pass
17	25.062	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3726	pass
18	25.064	12.37	12.36	12.37	12.37	12.35	12.35	Y	5.3611	pass
19	25.048	12.36	12.36	12.36	12.37	12.35	12.35	Y	5.3613	pass
20	25.096	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3572	pass
21	25.045	12.36	12.37	12.36	12.37	12.35	12.35	Y	5.3638	pass
22	25.111	12.36	12.36	12.36	12.37	12.35	12.35	Y	5.3715	pass
23	25.097	12.36	12.36	12.36	12.37	12.35	12.36	Y	5.3736	pass
24	25.043	12.36	12.36	12.37	12.37	12.35	12.36	Y	5.3445	pass
25	25.063	12.36	12.36	12.36	12.37	12.35	12.35	Y	5.3618	pass
26	25.036	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3586	pass
27	25.076	12.36	12.36	12.36	12.36	12.35	12.36	Y	5.3717	pass
28	25.109	12.36	12.36	12.37	12.37	12.35	12.35	Y	5.3619	pass
29	25.052	12.36	12.36	12.37	12.37	12.35	12.35	Y	5.3605	pass
30	25.039	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3685	pass
31	24.996	12.36	12.37	12.36	12.36	12.35	12.35	Y	5.3620	fail
32	25.027	12.35	12.36	12.36	12.36	12.36	12.35	Y	5.3497	pass
33	25.110	12.37	12.36	12.37	12.38	12.36	12.36	Y	5.3725	pass
34	25.083	12.36	12.36	12.36	12.36	12.37	12.37	Y	5.3589	pass
35	25.081	12.36	12.36	12.37	12.36	12.36	12.35	Y	5.3757	pass
36	25.025	12.38	12.37	12.38	12.36	12.35	12.35	Y	5.3503	pass
37	25.050	12.36	12.37	12.36	12.37	12.35	12.36	Y	5.3570	pass
38	25.087	12.36	12.36	12.36	12.36	12.35	12.35	Y	5.3541	pass
39	25.086	12.37	12.37	12.36	12.37	12.35	12.35	Y	5.3586	pass
40	25.072	12.37	12.37	12.37	12.37	12.35	12.35	Y	5.3745	pass

Comments
Page 1 of 2 For diameter measurement, top corresponds to compact end at top during pressing. Top end cap appears shinier than bottom.

Operator	Date
	5-8-06

QC Supervisor	Date
	5-12-06

QA Reviewer	Date
	6/23/06

Acceptance criteria for compact length:	≥25.02 and ≤25.40 mm
Acceptance criteria for compact diameter:	≥12.22 and ≤12.46 mm (and pass through 12.46 mm ring gauge)
Acceptance criteria for compact mass:	For information only

Comments	
Page 2 of 2	
For diameter measurement, top corresponds to compact end at top during pressing.	
Top end cap appears shinier than bottom.	

J.S. Cherry for M.C. Kincaid 6/23/06

Data Report Form DRF-25: Fuel Compact Mean Uranium Loading

Procedure:	AGR-CHAR-DAM-25 Rev. 1
Operator:	Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Filename:	\\mc-agr\AGR\UraniumLoading\LEU01-48T-Z_DRF25R1.xls

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Compact ID number:	5	8	21	39	50	57
Sample tube ID number:	U0605170101	U0605170201	U0605170301	U0605170401	U0605170501	U0605170601
Radiochemical laboratory analysis number:	060524-001	060524-002	060524-003	060524-004	060524-005	060524-006
Measured U in compact (g):	0.902	0.903	0.901	0.909	0.904	0.904
Uncertainty in measured U in compact (g):	0.001	0.001	0.001	0.001	0.001	0.001

Mean uranium loading (gU/compact):	0.904
Standard deviation in mean uranium loading (gU/compact):	0.003

Comments

<i>Fred C. Montgomery</i> Operator	<i>6-13-06</i> Date
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Data Report Form DRF-26A: Measurement of U Contamination and Impurities by Deconsolidation Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	40, 54, 62
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Deconsolidation-leach solution ID:	L0605230101	L0605300102	
Number of compacts:	3		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060605-036	060605-039	
Weight uranium leached (g):	4.05E-07	2.40E-08	4.29E-07
Uncertainty in weight uranium leached (g):	4.10E-08	2.40E-09	4.11E-08
Effective number of exposed kernels:	0.0	0.0	0.0
Uncertainty in effective number of exposed kernels:	0.0	0.0	0.0
Fe content of leach solution (μg):	6.31	2.29	8.60
Uncertainty in measured Fe content (μg):	1.30	0.46	1.38
Cr content of leach solution (μg):	0.289	0.132	0.42
Uncertainty in measured Cr content (μg):	0.029	0.013	0.03
Mn content of leach solution (μg):	0.083	0.013	0.10
Uncertainty in measured Mn content (μg):	0.008	0.003	0.01
Co content of leach solution (μg):	< 0.013	< 0.012	0.03
Uncertainty in measured Co content (μg):			
Ni content of leach solution (μg):	0.462	0.364	0.83
Uncertainty in measured Ni content (μg):	0.092	0.073	0.12
Ca content of leach solution (μg):	25.00	22.10	47.10
Uncertainty in measured Ca content (μg):	2.50	2.20	3.33
Al content of leach solution (μg):	11.30	9.89	21.19
Uncertainty in measured Al content (μg):	1.10	0.99	1.48
Ti content of leach solution (μg):	6.80	7.21	14.01
Uncertainty in measured Ti content (μg):	0.68	0.72	0.99
V content of leach solution (μg):	23.20	4.62	27.82
Uncertainty in measured V content (μg):	2.30	0.46	2.35

Comments

Ca measured by ICP-AES; All other elements by ICP-MS
FCM checked against IPA14300 official results 6/30/06

Fred C. Montgomery
Operator

7-12-06
Date

Data Report Form DRF-26A: Measurement of U Contamination and Impurities by Deconsolidation Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	18, 25, 52
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Deconsolidation-leach solution ID:	L0605230201	L0605300202	
Number of compacts:	3		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060605-037	060605-040	
Weight uranium leached (g):	4.67E-07	2.62E-08	4.93E-07
Uncertainty in weight uranium leached (g):	4.70E-08	2.60E-09	4.71E-08
Effective number of exposed kernels:	0.0	0.0	0.0
Uncertainty in effective number of exposed kernels:	0.0	0.0	0.0
Fe content of leach solution (μg):	2.79	3.90	6.69
Uncertainty in measured Fe content (μg):	0.56	0.78	0.96
Cr content of leach solution (μg):	0.259	0.156	0.42
Uncertainty in measured Cr content (μg):	0.026	0.016	0.03
Mn content of leach solution (μg):	0.044	0.051	0.10
Uncertainty in measured Mn content (μg):	0.009	0.01	0.01
Co content of leach solution (μg):	< 0.012	< 0.012	0.02
Uncertainty in measured Co content (μg):			
Ni content of leach solution (μg):	1.98	0.514	2.49
Uncertainty in measured Ni content (μg):	0.20	0.10	0.22
Ca content of leach solution (μg):	29.40	22.90	52.30
Uncertainty in measured Ca content (μg):	2.90	2.30	3.70
Al content of leach solution (μg):	15.30	19.50	34.80
Uncertainty in measured Al content (μg):	1.50	1.90	2.42
Ti content of leach solution (μg):	9.43	9.02	18.45
Uncertainty in measured Ti content (μg):	0.94	0.90	1.30
V content of leach solution (μg):	24.80	4.44	29.24
Uncertainty in measured V content (μg):	2.50	0.44	2.54

Comments

Ca measured by ICP-AES; All other elements by ICP-MS
FCM checked against IPA14300 official results 7/07/06

Fred C. Montgomery
Operator

7-12-06
Date

Data Report Form DRF-26A: Measurement of U Contamination and Impurities by Deconsolidation Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	10, 35, 42
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Deconsolidation-leach solution ID:	L0605300501	L0606010202	
Number of compacts:	3		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060605-043	060605-046	
Weight uranium leached (g):	7.21E-07	4.48E-08	7.66E-07
Uncertainty in weight uranium leached (g):	7.20E-08	4.50E-09	7.21E-08
Effective number of exposed kernels:	0.0	0.0	0.0
Uncertainty in effective number of exposed kernels:	0.0	0.0	0.0
Fe content of leach solution (μg):	6.21	3.86	10.07
Uncertainty in measured Fe content (μg):	0.62	0.77	0.99
Cr content of leach solution (μg):	0.59	0.19	0.78
Uncertainty in measured Cr content (μg):	0.059	0.019	0.06
Mn content of leach solution (μg):	0.076	0.047	0.12
Uncertainty in measured Mn content (μg):	0.008	0.009	0.01
Co content of leach solution (μg):	0.023	< 0.014	0.04
Uncertainty in measured Co content (μg):	0.005		0.005
Ni content of leach solution (μg):	0.499	0.333	0.83
Uncertainty in measured Ni content (μg):	0.10	0.033	0.11
Ca content of leach solution (μg):	20.90	55.10	76.00
Uncertainty in measured Ca content (μg):	2.10	5.50	5.89
Al content of leach solution (μg):	9.89	22.90	32.79
Uncertainty in measured Al content (μg):	0.99	2.30	2.50
Ti content of leach solution (μg):	8.16	8.42	16.58
Uncertainty in measured Ti content (μg):	0.82	0.84	1.17
V content of leach solution (μg):	24.40	4.63	29.03
Uncertainty in measured V content (μg):	2.40	0.46	2.44

Comments

Ca measured by ICP-AES; All other elements by ICP-MS
FCM checked against IPA14300 official results 7/07/06

Fred C. Montgomery
Operator

7-12-06
Date

Data Report Form DRF-26A: Measurement of U Contamination and Impurities by Deconsolidation Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	17, 26, 30
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Deconsolidation-leach solution ID:	L0605300601	L0606010302	
Number of compacts:	3		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060605-044	060605-047	
Weight uranium leached (g):	4.96E-07	4.66E-08	5.43E-07
Uncertainty in weight uranium leached (g):	5.00E-08	4.70E-09	5.02E-08
Effective number of exposed kernels:	0.0	0.0	0.0
Uncertainty in effective number of exposed kernels:	0.0	0.0	0.0
Fe content of leach solution (μg):	16.10	2.30	18.40
Uncertainty in measured Fe content (μg):	1.60	0.46	1.66
Cr content of leach solution (μg):	0.644	0.224	0.87
Uncertainty in measured Cr content (μg):	0.064	0.022	0.07
Mn content of leach solution (μg):	0.134	0.029	0.16
Uncertainty in measured Mn content (μg):	0.013	0.006	0.01
Co content of leach solution (μg):	0.026	< 0.013	0.04
Uncertainty in measured Co content (μg):	0.005		0.01
Ni content of leach solution (μg):	0.634	0.364	1.00
Uncertainty in measured Ni content (μg):	0.063	0.036	0.07
Ca content of leach solution (μg):	26.60	63.80	90.40
Uncertainty in measured Ca content (μg):	2.70	6.40	6.95
Al content of leach solution (μg):	10.90	10.00	20.90
Uncertainty in measured Al content (μg):	1.10	1.00	1.49
Ti content of leach solution (μg):	7.40	8.41	15.81
Uncertainty in measured Ti content (μg):	0.74	0.84	1.12
V content of leach solution (μg):	24.20	4.71	28.91
Uncertainty in measured V content (μg):	2.40	0.47	2.45

Comments

Ca measured by ICP-AES; All other elements by ICP-MS
FCM checked against IPA14300 official results 7/07/06

Fred C. Montgomery
Operator

7-12-06
Date

Data Report Form DRF-26A: Measurement of U Contamination and Impurities by Deconsolidation Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	11, 22, 32, 33, 51, 64
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Deconsolidation-leach solution ID:	L0606070101	L0606070302	
Number of compacts:	6		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060616-003	060616-005	
Weight uranium leached (g):	9.72E-07	6.47E-08	1.04E-06
Uncertainty in weight uranium leached (g):	9.70E-08	6.50E-09	9.72E-08
Effective number of exposed kernels:	0.0	0.0	0.0
Uncertainty in effective number of exposed kernels:	0.0	0.0	0.0
Fe content of leach solution (μg):	7.26	4.58	11.84
Uncertainty in measured Fe content (μg):	0.73	0.92	1.17
Cr content of leach solution (μg):	< 2.58	< 2.72	5.30
Uncertainty in measured Cr content (μg):			
Mn content of leach solution (μg):	< 0.368	< 0.388	0.76
Uncertainty in measured Mn content (μg):			
Co content of leach solution (μg):	< 1.03	< 1.09	2.12
Uncertainty in measured Co content (μg):			
Ni content of leach solution (μg):	< 1.83	< 1.93	3.76
Uncertainty in measured Ni content (μg):			
Ca content of leach solution (μg):	20.80	<19.30	40.10
Uncertainty in measured Ca content (μg):	4.20		4.20
Al content of leach solution (μg):	<18.30	<19.30	37.60
Uncertainty in measured Al content (μg):			
Ti content of leach solution (μg):	8.72	10.30	19.02
Uncertainty in measured Ti content (μg):	1.70	2.10	2.70
V content of leach solution (μg):	46.00	9.86	55.86
Uncertainty in measured V content (μg):	4.60	0.99	4.71

Comments

U measured by ICP-MS; All other elements by ICP-AES
FCM checked against IPA14319 official results 7/07/06

Fred C. Montgomery
Operator

7-12-06
Date

Data Report Form DRF-26A: Measurement of U Contamination and Impurities by Deconsolidation Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	01, 28, 47, 48, 49, 59
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Deconsolidation-leach solution ID:	L0606070201	L0606070402	
Number of compacts:	6		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060616-004	060616-006	
Weight uranium leached (g):	2.31E-06	7.54E-08	2.39E-06
Uncertainty in weight uranium leached (g):	2.30E-07	7.50E-09	2.30E-07
Effective number of exposed kernels:	0.0	0.0	0.0
Uncertainty in effective number of exposed kernels:	0.0	0.0	0.0
Fe content of leach solution (μg):	3.92	1.69	5.61
Uncertainty in measured Fe content (μg):	0.78	0.34	0.85
Cr content of leach solution (μg):	< 2.62	< 2.65	5.27
Uncertainty in measured Cr content (μg):			
Mn content of leach solution (μg):	< 0.373	< 0.378	0.75
Uncertainty in measured Mn content (μg):			
Co content of leach solution (μg):	< 1.04	< 1.06	2.10
Uncertainty in measured Co content (μg):			
Ni content of leach solution (μg):	1.92	< 1.88	3.80
Uncertainty in measured Ni content (μg):	0.38		0.38
Ca content of leach solution (μg):	<18.50	<18.80	37.30
Uncertainty in measured Ca content (μg):			
Al content of leach solution (μg):	<18.50	<18.80	37.30
Uncertainty in measured Al content (μg):			
Ti content of leach solution (μg):	9.73	11.60	21.33
Uncertainty in measured Ti content (μg):	1.90	2.30	2.98
V content of leach solution (μg):	46.70	11.20	57.90
Uncertainty in measured V content (μg):	4.70	1.10	4.83

Comments

U measured by ICP-MS; All other elements by ICP-AES
FCM checked against IPA14319 official results 7/07/06

Fred C. Montgomery
Operator

7-12-06
Date

Data Report Form DRF-26B: Measurement of SiC Burn-Leach Defects and Impurities by Burn-Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	40, 54, 62
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Burn-leach solution ID:	B0606080101	B0606120102	
Number of compacts:	3		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060616-007	060616-010	
Weight uranium leached (g):	1.06E-07	1.50E-09	1.08E-07
Uncertainty in weight uranium leached (g):	1.10E-08	1.50E-10	1.10E-08
Number of leached kernels:	0.0	0.0	0.0
Uncertainty in number of leached kernels:	0.0	0.0	0.0
Fe content of leach solution (μg):	3.56	0.80	4.36
Uncertainty in measured Fe content (μg):	0.36	0.16	0.39
Cr content of leach solution (μg):	< 0.707	< 0.707	1.41
Uncertainty in measured Cr content (μg):			
Mn content of leach solution (μg):	< 0.101	< 0.101	0.20
Uncertainty in measured Mn content (μg):			
Co content of leach solution (μg):	< 0.282	< 0.282	0.56
Uncertainty in measured Co content (μg):			
Ni content of leach solution (μg):	1.75	< 0.502	2.25
Uncertainty in measured Ni content (μg):	0.35		0.35
Ca content of leach solution (μg):	15.20	< 5.00	20.20
Uncertainty in measured Ca content (μg):	3.00		3.00
Al content of leach solution (μg):	8.63	< 5.00	13.63
Uncertainty in measured Al content (μg):	1.70		1.70
Ti content of leach solution (μg):	20.10	2.06	22.16
Uncertainty in measured Ti content (μg):	2.00	0.41	2.04
V content of leach solution (μg):	31.30	1.04	32.34
Uncertainty in measured V content (μg):	3.10	0.21	3.11

Comments

U measured by ICP-MS; All other elements by ICP-AES
FCM checked against IPA14319 official results 7/07/06

Fred C. Montgomery
Operator

7-12-06
Date

Data Report Form DRF-26B: Measurement of SiC Burn-Leach Defects and Impurities by Burn-Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	18, 25, 52
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Burn-leach solution ID:	B0606080201	B0606120202	
Number of compacts:	3		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060616-008	060616-011	
Weight uranium leached (g):	1.25E-07	1.09E-08	1.36E-07
Uncertainty in weight uranium leached (g):	1.30E-08	1.10E-09	1.30E-08
Number of leached kernels:	0.0	0.0	0.0
Uncertainty in number of leached kernels:	0.0	0.0	0.0
Fe content of leach solution (μg):	2.25	0.48	2.73
Uncertainty in measured Fe content (μg):	0.23	0.096	0.25
Cr content of leach solution (μg):	< 0.707	< 0.707	1.41
Uncertainty in measured Cr content (μg):			
Mn content of leach solution (μg):	< 0.101	< 0.101	0.20
Uncertainty in measured Mn content (μg):			
Co content of leach solution (μg):	< 0.282	< 0.282	0.56
Uncertainty in measured Co content (μg):			
Ni content of leach solution (μg):	5.84	2.89	8.73
Uncertainty in measured Ni content (μg):	0.58	0.29	0.65
Ca content of leach solution (μg):	20.40	6.44	26.84
Uncertainty in measured Ca content (μg):	4.10	1.30	4.30
Al content of leach solution (μg):	8.65	< 5.00	13.65
Uncertainty in measured Al content (μg):	1.70		1.70
Ti content of leach solution (μg):	15.20	< 0.86	16.06
Uncertainty in measured Ti content (μg):	1.50		1.50
V content of leach solution (μg):	35.40	0.85	36.25
Uncertainty in measured V content (μg):	3.50	0.17	3.50

Comments

U measured by ICP-MS; All other elements by ICP-AES
FCM checked against IPA14319 official results 7/07/06

Fred C. Montgomery
Operator

7-12-06
Date

Data Report Form DRF-26B: Measurement of SiC Burn-Leach Defects and Impurities by Burn-Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	10, 35, 42
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Burn-leach solution ID:	B0606120501	B0606130202	
Number of compacts:	3		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060616-014	060616-017	
Weight uranium leached (g):	2.11E-07	3.80E-09	2.15E-07
Uncertainty in weight uranium leached (g):	2.10E-08	3.80E-10	2.10E-08
Number of leached kernels:	0.0	0.0	0.0
Uncertainty in number of leached kernels:	0.0	0.0	0.0
Fe content of leach solution (μg):	2.86	0.62	3.48
Uncertainty in measured Fe content (μg):	0.29	0.12	0.31
Cr content of leach solution (μg):	< 0.707	< 0.707	1.41
Uncertainty in measured Cr content (μg):			
Mn content of leach solution (μg):	< 0.101	< 0.101	0.20
Uncertainty in measured Mn content (μg):			
Co content of leach solution (μg):	< 0.282	< 0.282	0.56
Uncertainty in measured Co content (μg):			
Ni content of leach solution (μg):	1.35	0.52	1.87
Uncertainty in measured Ni content (μg):	0.27	0.10	0.29
Ca content of leach solution (μg):	12.50	< 5.00	17.50
Uncertainty in measured Ca content (μg):	2.50		2.50
Al content of leach solution (μg):	8.29	< 5.00	13.29
Uncertainty in measured Al content (μg):	1.70		1.70
Ti content of leach solution (μg):	9.89	5.25	15.14
Uncertainty in measured Ti content (μg):	0.99	0.53	1.12
V content of leach solution (μg):	32.70	1.23	33.93
Uncertainty in measured V content (μg):	3.30	0.25	3.31

Comments

U measured by ICP-MS; All other elements by ICP-AES
FCM checked against IPA14319 official results 7/07/06

Fred C. Montgomery
Operator

7-12-06
Date

Data Report Form DRF-26B: Measurement of SiC Burn-Leach Defects and Impurities by Burn-Leach

Procedure:	AGR-CHAR-DAM-26 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	17, 26, 30
DRF filename:	\\mc-agr\AGR\LeachBurnLeach\LEU01-48T-Z_DRF26R0.xls

Mean average weight/kernel (g):	2.42E-04
Uncertainty in mean average weight/kernel (g):	5.96E-07
Mean weight % uranium/kernel:	90.06
Standard deviation in weight % uranium/kernel:	0.09
Approximate weight uranium/kernel (g):	2.18E-04
Uncertainty in approx. weight uranium/kernel (g):	5.76E-07

	First Leach	Second Leach	Total
Burn-leach solution ID:	B0606120601	B0606130302	
Number of compacts:	3		
Volume of leach solution (ml):			
Measured β activity of 0.1ml aliquot (dpm):			
Estimated weight of U in leach solution (mg):			
Radiochemical laboratory analysis number:	060616-015	060616-018	
Weight uranium leached (g):	2.30E-04	2.00E-07	2.30E-04
Uncertainty in weight uranium leached (g):	2.30E-05	2.00E-08	2.30E-05
Number of leached kernels:	1.1	0.0	1.1
Uncertainty in number of leached kernels:	0.1	0.0	0.1
Fe content of leach solution (μg):	2.86	0.78	3.64
Uncertainty in measured Fe content (μg):	0.29	0.16	0.33
Cr content of leach solution (μg):	< 0.707	< 0.707	1.41
Uncertainty in measured Cr content (μg):			
Mn content of leach solution (μg):	< 0.101	< 0.101	0.20
Uncertainty in measured Mn content (μg):			
Co content of leach solution (μg):	< 0.282	< 0.282	0.56
Uncertainty in measured Co content (μg):			
Ni content of leach solution (μg):	4.33	2.18	6.51
Uncertainty in measured Ni content (μg):	0.43	0.44	0.62
Ca content of leach solution (μg):	12.60	< 5.00	17.60
Uncertainty in measured Ca content (μg):	2.50		2.50
Al content of leach solution (μg):	9.01	< 5.00	14.01
Uncertainty in measured Al content (μg):	1.80		1.80
Ti content of leach solution (μg):	15.60	5.89	21.49
Uncertainty in measured Ti content (μg):	1.60	0.59	1.71
V content of leach solution (μg):	32.60	0.89	33.49
Uncertainty in measured V content (μg):	3.30	0.18	3.30

Comments

U measured by ICP-MS; All other elements by ICP-AES
FCM checked against IPA14319 official results 7/07/06

Fred C. Montgomery
Operator

7/2-06
Date

Data Report Form DRF-27: Counting of Particles with a Defective OPyC Layer from Deconsolidated Compacts by Visual Inspection

Procedure:	AGR-CHAR-DAM-27 Rev. 0
Operator:	Fred Montgomery
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID number:	31
DRF filename:	\\mc-agr\AGR\DefectiveOPyC\LEU01-48T-Z_DRF27R0.xls

Number of particles with cracked OPyC:	0
Number of particles with partially missing OPyC:	0
Number of particles with completely missing OPyC:	0
Total number of particles with defective OPyC:	0

Comments on unusual visual characteristics of OPyC

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Fred C. Montgomery

Operator

6/27/06

Date

Data Report Form DRF-28: Counting of Particles with Excessive Uranium Dispersion Inside SiC

Procedure:	AGR-CHAR-DAM-28 Rev. 1
Operator:	John Hunn
Compact lot ID:	LEU01-48T-Z
Compact lot description:	Compacts of AGR-1 variant 2 coated particle composite LEU01-48T
Compact ID numbers:	40,54,62,18,25,52,10,35,42,17,26,30
DRF filename:	\\mc-agr\AGR\DefectiveIPyC\LEU01-48T-Z_DRF28R1.xls

Number of compacts from which particles were recovered:	12
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Weight of sample of particles (g):	28.932
Number of particles in sample:	49555
Mean average weight/particle (g):	5.84E-04

Number of particles with excessive U dispersion:	0
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Comments

Particles noted with <300 μm diameter kernel: 18/49555 (fraction of compact lot with this anomaly: $\leq 5.4\text{E-}4$ at 95% confidence).
 Particles noted with <20 μm thick SiC: 33/49555 (fraction of compact lot with this anomaly: $\leq 9.0\text{E-}4$ at 95% confidence).
 Other anomalies observed included highly aspherical kernel shapes, faceted particles, and defects related to goldspots (soot inclusions).

 Operator	7-17-06 Date
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For Information Only

The information in the remainder of this section is from additional characterization that was not required by the fuel product specification.

A. Images of AGR-1 variant 2 compact lot LEU01-48T-Z

The following images are of two compacts randomly selected from compact lot LEU01-48T-Z.

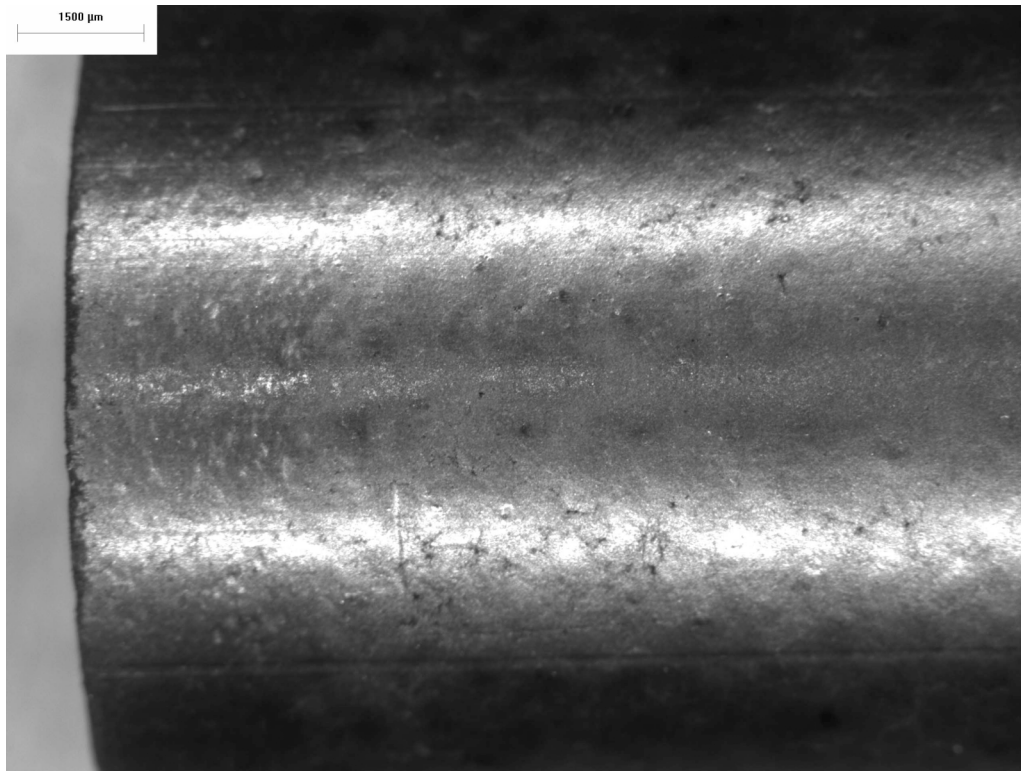


Figure A-1: Bottom of compact LEU01-48T-Z04 (7th compact fabricated).

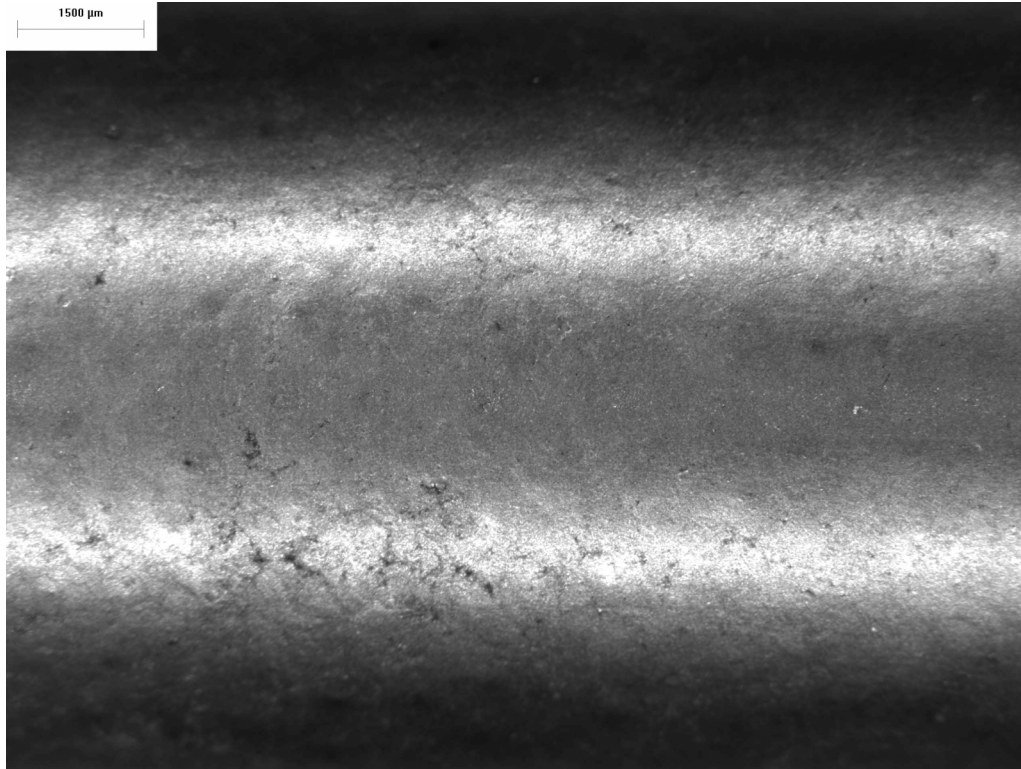


Figure A-2: Middle of compact LEU01-48T-Z04 (7th compact fabricated).

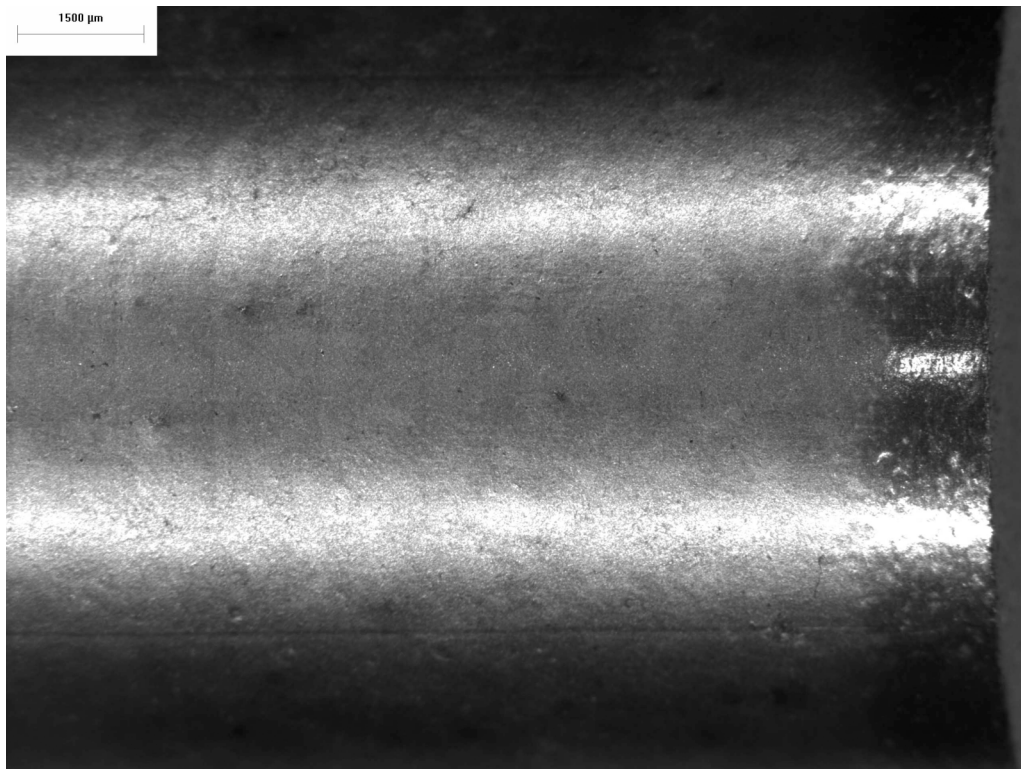


Figure A-3: Top of compact LEU01-48T-Z04 (7th compact fabricated).

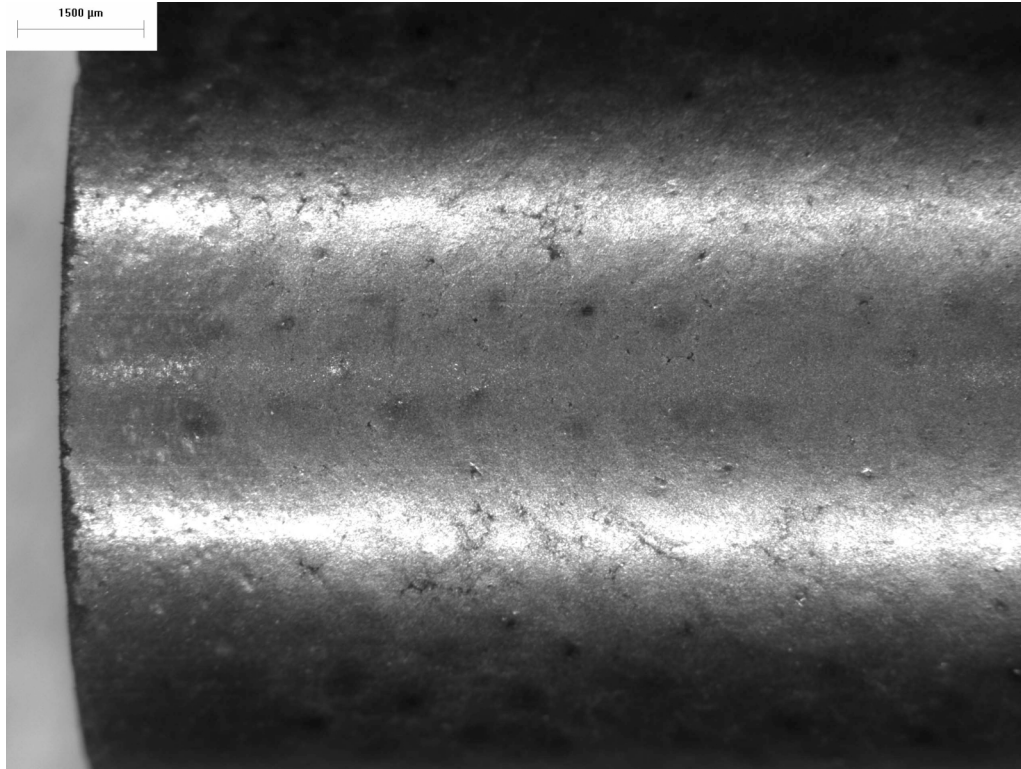


Figure A-4: Bottom of compact LEU01-48T-Z06 (11th compact fabricated).

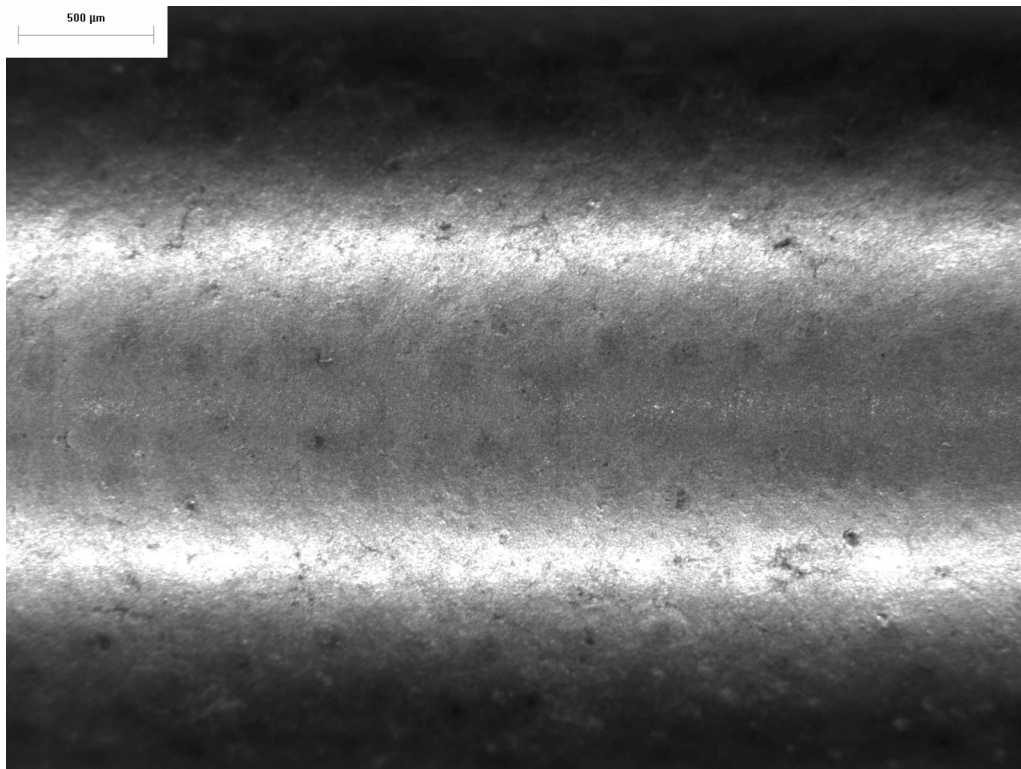


Figure A-5: Middle of compact LEU01-48T-Z06 (11th compact fabricated).

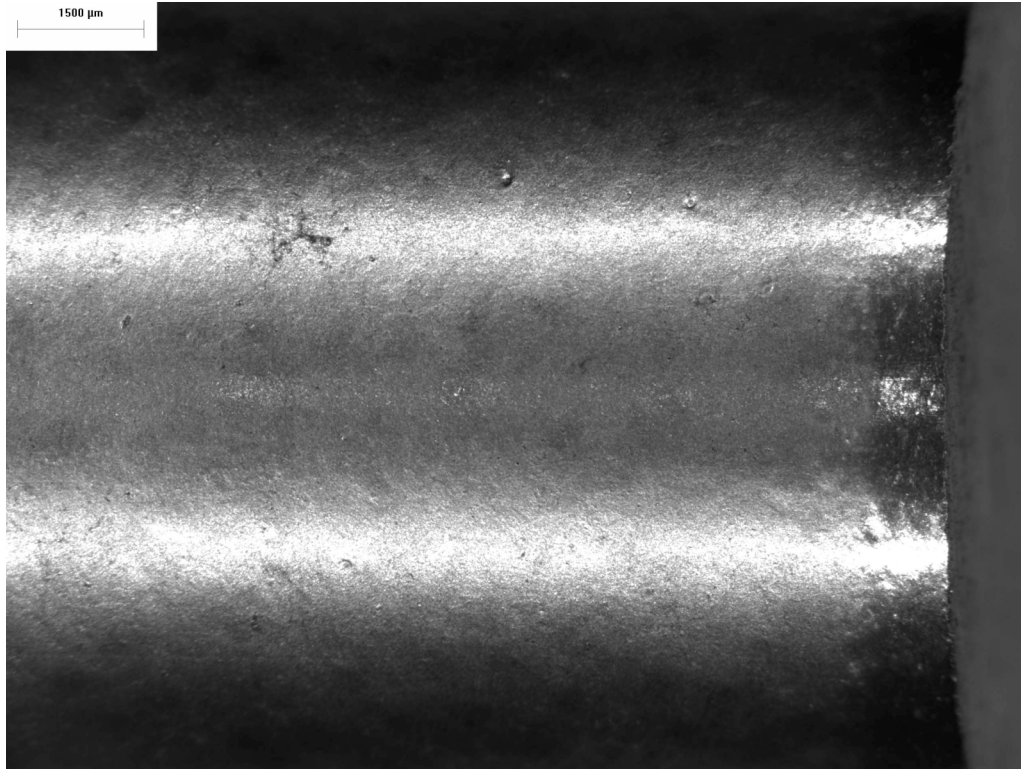


Figure A-6: Top of compact LEU01-48T-Z06 (11th compact fabricated).

B. Anisotropy of pyrocarbon layers after compacting

To examine the change in pyrocarbon anisotropy during compact fabrication, particles were recovered after deconsolidation of the particles from the compact for defective OPyC analysis. After compacting, the anisotropy of the pyrocarbon layers was observed to increase. This increase is thought to occur during the heat treatment of the compacts at 1800°C for 1 hour. The diattenuation of the IPyC increased from 0.0075 ± 0.0006 to 0.0121 ± 0.0004 (1.0225 ± 0.0019 to 1.0362 ± 0.0011 in terms of effective BA_{Fo}). The diattenuation of the OPyC increased from 0.0059 ± 0.0004 to 0.0097 ± 0.0013 (1.0176 ± 0.0011 to 1.0290 ± 0.0038 in terms of effective BA_{Fo}). The following two DRF's contain the data for these measurements.

Data Report Form DRF-18A: Measurement of Pyrocarbon Anisotropy using the 2-MGEM - IPyC

Procedure:	AGR-CHAR-DAM-18 Rev. 1
Operator:	G. E. Jellison
Mount ID:	M06071101L
Sample ID:	LEU01-48T-Z31
Sample Description:	Particles deconsolidated from AGR-1 variant 2 compact
Folder containing data:	\\mc-agr\AGR\2-MGEM\R06072501\

Particle #	Grid Position	Diattenuation			Equivalent BAFO		
		Average	St. Dev.	Ave. Error	Average	St. Dev.	Ave. Error
1	3,4	0.0116	0.0040	0.0011	1.0348	0.0120	0.0033
2	3,5	0.0125	0.0038	0.0012	1.0375	0.0114	0.0036
3	3,6	0.0123	0.0037	0.0012	1.0369	0.0111	0.0036
4	3,7	0.0119	0.0030	0.0011	1.0357	0.0090	0.0033
5	4,4	0.0115	0.0039	0.0012	1.0345	0.0117	0.0036
6	4,5	0.0125	0.0035	0.0012	1.0375	0.0105	0.0036
7	4,6	0.0125	0.0029	0.0013	1.0375	0.0087	0.0039
8	4,7	0.0118	0.0029	0.0012	1.0354	0.0087	0.0036
9	5,4	0.0121	0.0038	0.0012	1.0363	0.0114	0.0036
10	5,6	0.0119	0.0034	0.0012	1.0357	0.0102	0.0036
Average		0.0121	0.0035	0.0012	1.0362	0.0105	0.0036

Mean of average BAFO per particle:	1.0362
Standard deviation of average BAFO per particle:	0.0011

Comments

G. E. Jellison
Operator

July 25, 2006
Date

Data Report Form DRF-18B: Measurement of Pyrocarbon Anisotropy using the 2-MGEM - OPyC

Procedure:	AGR-CHAR-DAM-18 Rev. 1
Operator:	G. E. Jellison
Mount ID:	M06071101L
Sample ID:	LEU01-48T-Z31
Sample Description:	Particles deconsolidated from AGR-1 variant 2 compact
Folder containing data:	\\mc-agr\AGR\2-MGEM\R06072501\

Particle #	Grid Position	Diattenuation			Equivalent BAFO		
		Average	St. Dev.	Ave. Error	Average	St. Dev.	Ave. Error
1	3,4	0.0104	0.0034	0.0014	1.0312	0.0102	0.0042
2	3,5	0.0110	0.0045	0.0021	1.0330	0.0135	0.0063
3	3,6	0.0078	0.0037	0.0032	1.0234	0.0111	0.0096
4	3,7	0.0089	0.0033	0.0025	1.0267	0.0099	0.0075
5	4,4	0.0104	0.0036	0.0017	1.0312	0.0108	0.0051
6	4,5	0.0099	0.0031	0.0018	1.0297	0.0093	0.0054
7	4,6	0.0094	0.0038	0.0030	1.0282	0.0114	0.0090
8	4,7	0.0079	0.0034	0.0033	1.0237	0.0102	0.0099
9	5,4	0.0092	0.0033	0.0017	1.0276	0.0099	0.0051
10	5,6	0.0116	0.0035	0.0018	1.0348	0.0105	0.0054
Average		0.0097	0.0036	0.0023	1.0290	0.0107	0.0068

Mean of average BAFO per particle:	1.0290
Standard deviation of average BAFO per particle:	0.0038

Comments

G. E. Jellison
Operator

July 25, 2006
Date